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# THE NEW YORK LATIN LEAFLET

Entered at the Post Office in Brooklyn as second-class matter, October 29, 1900

**25 Issues**

**One-half of Every Subscription goes into the Scholarship Fund**

VOL VI BROOKLYN, NEW YORK, NOV 6, 1905 NO 131

## IMPORTANT NOTICE

### SIXTEENTH MEETING OF THE LATIN CLUB—DEC 2, 1905

**Professor Benjamin L D'Ooge of Michigan State Normal College will address the club on the subject, "Essentials and Non-Essentials" at the Hotel Marlborough, Thirty-fifth street and Broadway, New York City. Be sure to notify "THE LATIN LEAFLET", 1050 Bergen street, Brooklyn, by postal card, if you intend to be present. ATTEND TO THIS MATTER NOW.**

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The following material is presented in *The Leaflet* not only because of its plain connection with the study of Greek, but because of its unity and availability as an opening exercise for schools. In fact it was thus used with good effect at an opening exercise in the Eastern District High School, Brooklyn, by a class under the direction of Mr H O Rittenhouse, who was responsible for the material and through whose courtesy we are enabled to present it.

## GEOMETRY

Among the mysteries of the Universe that have engaged the study of philosophers none is greater than that of the space in which we live. It exists in every place whether that place is occupied by matter or not. It is without center and without boundary. It is inconceivable in its entirety. If we try to think of it as having no boundary our finite minds cannot embrace it. If we try to think of it as having a boundary, we immediately recognize its further existence beyond the boundary. It is incapable of definition by descriptive terms. It is colorless, odorless, tasteless, silent and elusive.

But while it is thus beyond the grasp of the senses, and in its wholeness is unintelligible, yet both philosophers and mathematicians have discovered many of its properties and laws by means of the science of Geometry.

It is known that the Egyptians knew something, at least, of Geometry in the earliest historical period. It is certain that they knew how to obtain a right-angle by a rope divided proportionately to the numbers 3, 4 and 5. It is probable that even at that early day they knew many more geometrical truths.

The Babylonians knew how to divide the circle into six equal parts, and from this to subdivide into 360 degrees.

In the study of Geometry we assume points, lines and surfaces as the *elements* of space. These are to the Geometer, what atoms and molecules are to the chemist. Reasoning upon these elements in accordance with certain truths universally accepted as axiomatic we reach conclusions not only in accord with our judgment, but which are constantly verified by measurement and experience. From such well established conclusions others equally valid may be found, and the possibilities of the development are unlimited. These conclusions, called theorems, are the properties of space; and they constitute in the truest sense the fundamental laws of the Universe.

Should a single one of these laws by any possibility fail in its application, space would cease to exist as it is and new and indescribable conditions would ensue.

Perhaps the most important and far-reaching of these laws is the fact that "the square of the hypotenuse of a right-triangle is equal to the sum of the squares of the other two sides".

The importance to mankind of a knowledge of Geometry is evidenced by the fact that it is the basis of every important constructive operation and is the principal tool in the development of the exact and the applied sciences.

Geometry designed the pyramids, the temples of Greece, the roads and aqueducts of Rome, the Cathedrals of Europe, and all the great modern bridges, tunnels, and canals. The operation of every mechanical engine is subject to its laws. It builds the instruments of war, such as forts, battleships, guns and projectiles, that often determine the destiny of nations and races. By it the Navigator directs his course. By it the Astronomer learns the secrets of the heavens. It offers new and inexhaustible fields of research to every lover of truth, and the application of its laws is as wide as the domain of human activities.

### EUCLID

The most renowned Geometer of all time is Euclid, who lived about 300 B C. This period is known as the golden era in Greek mathematical history. We are ignorant not only of the dates of his birth and death, but of his parentage, his teachers, and his residence in early life. He was familiar with the philosophy of Plato, and the final aim of his geometric work was to establish the truths of the Platonic figures, known to us as the regular solids.

Euclid discovered many new truths, improved and perfected many proofs and wrote a number of books. The most celebrated of his writings is called *The Elements*. With the exception of the Sacred Writings no Greek has been so much read or so variously translated as Euclid's Elements. For nearly twenty centuries without significant change it has been the gateway to mathematical knowledge, and in many of the leading schools in England today Geometry is taught from a close translation of Euclid's original text.

Euclid's fame rests, in large degree, upon his work in compiling and systematizing the truths previously discovered. It is not claimed that he originated all the theorems that he published. But, in the Elements he did for Geometry what Homer did for the poetry of Greece, what Shakspeare did for English drama, and what Blackstone did for the Common Law.

Among the geometrical axioms assumed by Euclid is that called the axiom of parallels, which asserts that through a given point only one line can be drawn parallel to a given line.

While the truth of this statement is not denied, many mathematicians contend that the idea is not simple and obvious enough to be classed as an axiom, and demands proof as a theorem. But all efforts to discover a logical proof of this proposition from other recognized axioms and theorems have failed. And all efforts to establish Greek geometry upon any basis that does not include the axiom of parallels, or its equivalent, have failed.

Very little is known of the life of Euclid. The following story is given by an ancient writer: A youth who had begun to read Geometry with Euclid, when he had learned the first proposition, inquired, "What do I get by learning these things?" So Euclid called his slave and said, "Give him three-"pence since he must gain out of what he learns".

### ARCHIMEDES

Archimedes was born at Syracuse in Sicily about 287 B C. In his youth he went to Alexandria where he was educated in the Royal school. He is acknowledged the greatest mathematician and the most inventive genius of antiquity.

He advanced the science of Geometry far beyond the limits it had attained when he commenced his studies, and he is justly renowned for his scientific inventions. He was the great pioneer of scientific engineering and established it upon a solid mathematical basis.

He devised many engines of war with which to oppose the Romans at the siege of Syracuse. Among his exploits at that time he is sometimes credited with having set the Roman ships on fire by concentrating upon them the rays of the sun by means of large mirrors. While this story may well be doubted, yet it is highly probable that he experimented with such mirrors.

Among his most famous discoveries are some of the fundamental principles governing the action of liquids. At the suggestion of King Hiero, he had for a long time been trying to find a simple method for the detection of base metal in coins and other articles of value, but without success. One day as he stepped into his bath he observed the water displaced by his body, overflowing the basin. Reflecting upon this circumstance he quickly perceived the important principle in hydrostatics that a body immersed in a liquid sustains an upward pressure equal to the weight of liquid displaced. So delighted was he with this discovery which enabled him to solve the problem that had so long baffled him that he ran through the streets shouting "Eureka, Eureka, I have found it".

He invented a very simple but efficient device for pumping water, which still bears his name, called the screw of Archimedes. It was extensively used in raising water from the Nile, and in pumping out ships.

He explained and developed the principle of the lever and fulcrum, and so enthusiastic was he over the power that could be gained by this instrument, that he said: "Give me a fulcrum upon which to rest and I can move the world".

He discovered that the ratio of the circumference of a circle to its diameter is very nearly twenty-two sevenths, which is more accurate than any previous value that had been known, and is in general use to-day in ordinary computations.

Notwithstanding the fame accorded him by his countrymen for his great scientific ability, he took far more personal pride in his discoveries in Geometry. He was the first to show that the surface of a sphere is exactly equal to that of four of its great circles; that it is also exactly equal to the curved surface of the circumscribed cylinder; that both the surface and the volume of a sphere are each equal to two-thirds of the entire surface and volume, respectively, of the circumscribed cylinder.

So happy was he over the discovery of these simple relations that he expressed the wish to have the figures of the cylinder and sphere inscribed upon his tomb. This wish was respected, and many years after his death when his burial place had been neglected and forgotten, it was identified by these devices.

The story of his death is pathetic. When the Romans captured Syracuse, 212 B C., a great massacre followed the victory. He was found studying a geometrical diagram drawn in the sand. As the Romans approached he called out, "Don't spoil my circles!" But a soldier drew his sword and put him to death.

### MODERN METHODS IN GEOMETRY

Geometry made but little advance during eighteen centuries following the period of Archimedes. The Greeks fully mastered the triangle, simple polygons, and the circle and computed the areas of these figures. In solid Geometry nearly all the important truths of the three round bodies, cone, cylinder and sphere, were known and their volumes determined.

Many theorems were also known of a class of simple curves called conic sections.

One very plausible reason for the lack of progress during this interval is found in the fact that before the development of algebra *the proportion* was the chief instrument of mathematical analysis. The *proportion,* at best, is cumbersome as compared with the direct equation, and it was entirely inadequate to deal satisfactorily and concisely with the more advanced propositions. As the subject deepened the proofs became more tedious and involved, and when finally accomplished, the results were hardly suitable for presentation to any but accomplished scholars.

In the sixteenth century a remarkable impulse was given to the development of algebra. One of the first to recognize its power was a young Frenchman named René Descartes, born in 1596.

The fame of Descartes as a philosopher has greatly obscured his genius as a mathematician. To him we are indebted for many important discoveries in the science of mathematics; but among these, one stands pre-eminent as marking a new epoch in Geometry. By a skillful device he applied the power of Algebra to the problems of geometry and gained, with ease, solutions and demonstrations which, up to that time, had been obtained only by wearisome proportions whose sequence could scarcely be remembered.

His method is known as Analytical Geometry, and, since its discovery all branches of mathematics have been greatly advanced, and it remains to-day the principal instrument of research in nearly every field of the science.

The advent of Analytical Geometry diverted scholars, for about two centuries from the study of pure geometry such as that which the Greeks gave us. But in recent years interest in pure geometry has revived, and, under various names and methods new fields have been entered and many brilliant results achieved.

But notwithstanding the new methods, notwithstanding the increased knowledge, notwithstanding the living forces embodied in Newton, in Hamilton, and in Gauss, no significant advance has been made along the line of the classic geometry as it was imparted to us by the Greek masters. Like the beauty of their temples, their geometry, in simplicity, elegance and perfection has been the model to which the civilization of more than twenty centuries has turned for instruction.

THE NEW YORK LATIN LEAFLET
DAVID H HOLMES, PhD, *Editor-in-Chief*
**1056 BERGEN ST, BROOKLYN** **Telephone 2516R Bedford**
*Published by the New York Latin Club in Support of The New York High School College Entrance Scholarship Fund*

Printed by the ROEHR PUBLISHING CO, 35 Myrtle Ave, Brooklyn, N Y

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## A LATIN PERFORMANCE AT THE NORMAL COLLEGE, NEW YORK CITY

For the second year now the alumnae, the instructors, and others, interested in the study of classical antiquities, have banded themselves together as the Classical Club of the Normal College, New York City.

Last year the members listened to a series of instructive lectures, given by prominent scholars. This year they have broadened the scope of their organization. In the front rank there are the Study Courses offered to the members and others. These comprise First and Second Year Greek, Latin Prose Composition, and the Satires and Epistles of Horace, all under the guidance of competent instructors. There are also to be originals papers by the members of the club, and a number of the lectures on classical topics. These are given on the second Friday of each month, at 4 P M.

In order to arouse the widest interest, however, the club has decided to present this year, on Saturday, November 11, at 2 P M, in the chapel of the college, scenes from Latin Comedies, in costume, and as far as possible, with attention to the archaeological details of the play.

Owing to the somewhat ambitious character of the performance, and to enlarge the circle of interested friends, it has been decided to admit the general public for a small entrance fee, the profits from which will go to the Scholarship Fund of the college. The entertainment promises to be of interest not only to the immediate friends of the college, but also to the large number of Latin teachers in New York and vicinity, and the editors of the Leaflet hope with the officers of the club that their expectations may be realized. Those of us who remember the enjoyment and instruction derived from the presentation of Sophocles's Aias some years ago under the auspices of native Greeks living in New York City will certainly be hopeful that the same effect will result from the courageous undertaking of the Classical Club of the Normal College.

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